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13. ABSTRACT (Maximum 200 words)

In this project, sensors for land mine detection research were purchased. The sensors included a ground penetrating radar system operating at 1200 Mhz, as well as a long wave IR camera. A weather station and time domain reflectometry system for monitoring soil water content were also purchased. The sensors have been used in support of an ongoing research program in modeling soil physical properties and their effect on the performance IR and GPR sensors for landmine detection. Data from the IR camera and GPR system, in conjunction with soil water content measurements have been used to help validate theoretical models of the performance of the IR and GPR sensors for landmine detection. The IR camera and GPR system have also been mounted on a mobile robot. This robot is under development within the electrical engineering department at New Mexico Tech.

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Land mines, Infrared Sensors, Ground Penetrating Radar (GPR)

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Statement of the Problem Studied

Many efforts have been made to develop sensors for the detection of landmines, including thermal IR imaging, ground penetrating radar, acoustic methods, and chemical detectors. However, relatively little has been done to model the effects of soil physical properties on the performance of these sensors. It is now understood from field experience that the performance of these sensors can be greatly effected by soil physical properties such as soil texture and water content. The group at New Mexico Tech has been working on modeling the effect of these soil physical properties on GPR and Infrared sensors. In this project, the group at New Mexico Tech acquired sensors that are being used to validate the modeling results. A secondary goal of the project was to fit the IR camera and GPR system on New Mexico Tech's mobile robot platform in support of robotics research being conducted in the electrical engineering department.

Summary of Important Results

The equipment described in the original proposal was purchased over the summer of 2000. There were considerable delays in delivery of some of the equipment. In particular, the IR camera and its wide angle lens were not available until February of 2001. However, all of the requested equipment has now been delivered. The students and other researchers in the group have learned to operate the equipment, and some preliminary results have been obtained. These results were reported at the SPIE meeting in April of 2001. Field work is continuing over the summer of 2001, and additional publications should eventually result from this work.

Furthermore, the ground penetrating radar and IR camera have successfully been adapted to fit on the mobile robot. Figure 1 shows the robot in the field with the IR camera and GPR antenna. Work with the robot is ongoing.

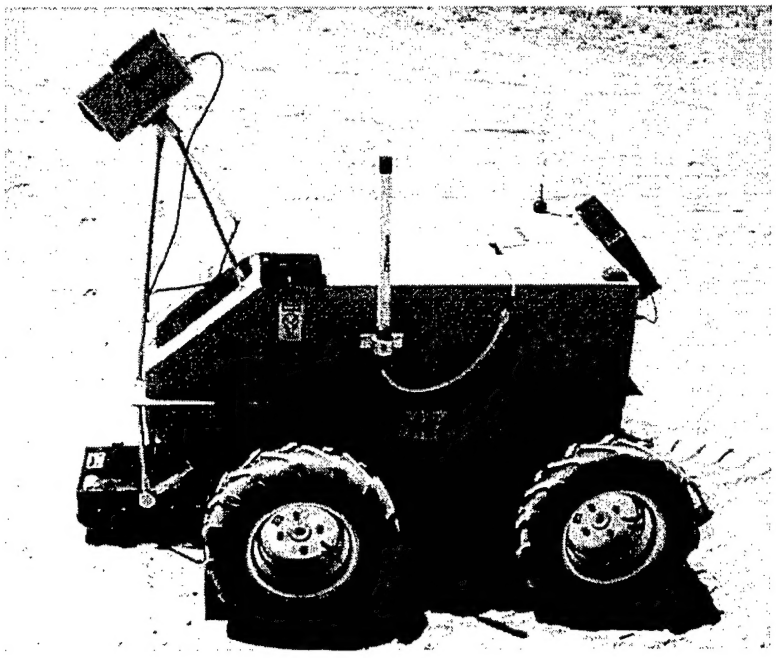

Figure 1: The Mobile Robot with GPR and IR Camera.

Publications

J. M. H. Hendrickx, B. Borchers, and J. Woolslayer, L. W. Dekker, C. Ritsema, and S. Paton. Spatial Variability of Dielectric Properties in Field Soils. To Appear in *Detection and Remediation Techniques for Mines and Minelike Targets VI.*

S. Hong, T. Miller, H. Tobin, B. Borchers and J. M. H. Hendrickx. Impact of Soil Water Content on Landmine Detection Using Radar and Thermal Infrared Sensors. To Appear in *Detection and Remediation Techniques for Mines and Minelike Targets VI.*

J. Simunek, J. M. H. Hendrickx and B. Borchers. Modeling Transient Temperature Distributions Around Landmines in Homogenous Bare Soils. . To Appear in *Detection and Remediation Techniques for Mines and Minelike Targets VI.*

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